Domestic Uses and Safety

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.2 Electricity
Sub-Topic	Domestic Uses and Safety
Difficulty Level	Gold Level
Booklet	Question Paper 1

Time Allowed: **58 minutes**

Score: **/58**

Percentage: **/100**

Grade Boundaries:

Q1. Solar panels are often seen on the roofs of houses.

(a) Describe the action and purpose of a solar panel.

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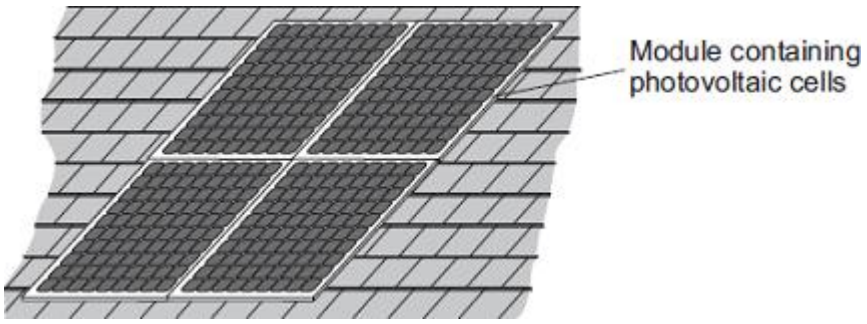
(2)

(b) Photovoltaic cells transfer light energy to electrical energy.

In the UK, some householders have fitted modules containing photovoltaic cells on the roofs of their houses.

Four modules are shown in the diagram.



The electricity company pays the householder for the energy transferred.

The maximum power available from the photovoltaic cells shown in the diagram is 1.4×10^3 W.

How long, in minutes, does it take to transfer 168 kJ of energy?

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..... Time = ... minutes

(3)

(c) When the modules are fitted on a roof, the householder gets an extra electricity meter to measure the amount of energy transferred by the photovoltaic cells.

(i) The diagram shows two readings of this electricity meter taken three months apart.
The readings are in kilowatt-hours (kWh).

21 November

0	0	0	4	4

21 February

0	0	1	9	4

Calculate the energy transferred by the photovoltaic cells during this time period.

.....

Energy transferred = ... kWh

(1)

(ii) The electricity company pays 40p for each kWh of energy transferred.

Calculate the money the electricity company would pay the householder.

.....

.....

Money paid = ...

(2)

(iii) The cost of the four modules is £6000.

Calculate the payback time in years for the modules.

.....

.....

Payback time = ... years

(3)

(iv) State an assumption you have made in your calculation in part **(iii)**.

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.....

(1)

(d) In the northern hemisphere, the modules should always face south for the maximum transfer of energy.

State **one** other factor that would affect the amount of energy transferred during daylight hours.

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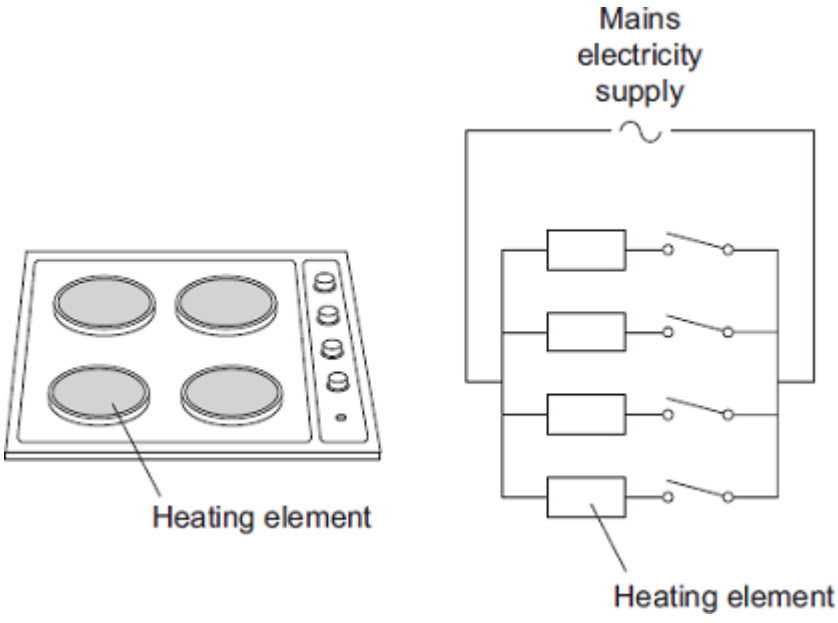
(1)
(Total 13 marks)

Q2. The picture shows an electric cooker hob. The simplified circuit diagram shows how the four heating elements connect to the mains electricity supply. The heating elements are identical.



When all four heating elements are switched on at full power the hob draws a current of

26 A from the 230 V mains electricity supply.

(a) Calculate the resistance of one heating element when the hob is switched on at full power.

Give your answer to 2 significant figures.

.....

.....

.....

Resistance = ... Ω

(3)

(b) The table gives the maximum current that can safely pass through copper wires of different cross-sectional area.

Cross-sectional area in mm^2	**Maximum safe current in amps**
1.0	**11.5**
2.5	**20.0**
4.0	**27.0**
6.0	**34.0**

The power sockets in a home are wired to the mains electricity supply using cables containing 2.5 mm^2 copper wires. Most electrical appliances are connected to the mains electricity supply by plugging them into a standard power socket.

It would **not** be safe to connect the electric cooker hob to the mains electricity supply by plugging it into a standard power socket.

Why?

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(2)

(c) Mains electricity is an alternating current supply. Batteries supply a direct current.

What is the difference between an alternating current and a direct current?

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(2)
(Total 7 marks)

Q3.(a) Describe the difference between an alternating current (a.c.) and a direct current (d.c.).

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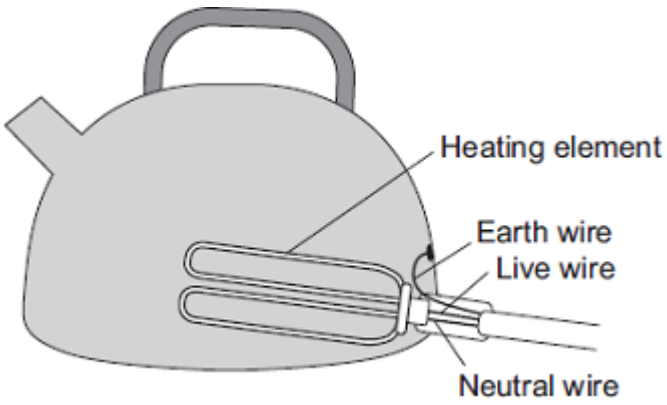
(2)

(b) The diagram shows how the electric supply cable is connected to an electric kettle. The earth wire is connected to the metal case of the kettle.



If a fault makes the metal case live, the earth wire and the fuse inside the plug protect anyone using the kettle from an electric shock.

Explain how.

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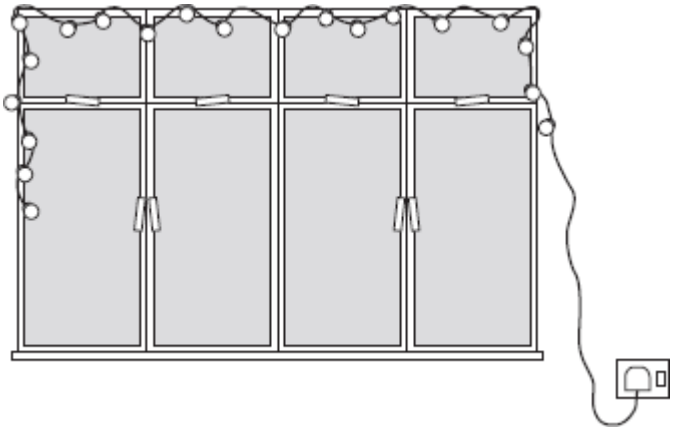
(2)
(Total 4 marks)

Q4. A set of lights consists of 20 lamps connected in series to the 230 V mains electricity supply.



(a) When the lights are switched on and working correctly, the current through each lamp is 0.25 A.

(i) What is the total current drawn from the mains supply?

.....

(1)

(ii) Calculate the charge passing through **one** of the lamps in 5 minutes.

Show clearly how you work out your answer and give the unit.

.....

.....

.....

.....

Total charge = ...

(3)

(b) One of the lamps in the set is a fuse lamp. This contains a filament which melts if a fault occurs. A short time after the lights are switched on, a fault causes the filament inside the fuse lamp to melt and all the lamps go out.

The householder cannot find another fuse lamp so connects a piece of aluminium foil across the contacts inside the fuse lamp holder.
When switched on, the nineteen remaining lamps work.
What the householder has done is dangerous.

Explain why.

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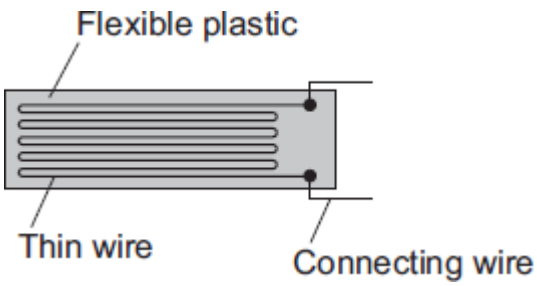
(2)
(Total 6 marks)

Q5. The diagram shows a strain gauge, which is an electrical device used to monitor a changing force.

Applying a force to the gauge causes it to stretch.
This makes the electrical resistance of the wire change.



(a) (i) Using the correct symbols, **add** to the diagram to show how a battery, an ammeter and a voltmeter can be used to find the resistance of the strain gauge drawn above.

(2)

(ii) When in use, the strain gauge is always connected to a d.c. power supply, such as a battery.

How is a d.c. (direct current) power supply different from an a.c. (alternating current) power supply?

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(1)

(b) Before any force is applied, the unstretched gauge, correctly connected to a 3.0 V battery, has a current of 0.040 A flowing through it.

(i) Calculate the resistance of the unstretched gauge.

Show clearly how you work out your answer.

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.....

Resistance = ... Ω

(2)

(ii) Stretching the gauge causes the current flowing through the gauge to decrease.

What happens to the resistance of the gauge when it is stretched?

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(1)

(iii) What form of energy is stored in the gauge when a force is applied and the gauge stretches?

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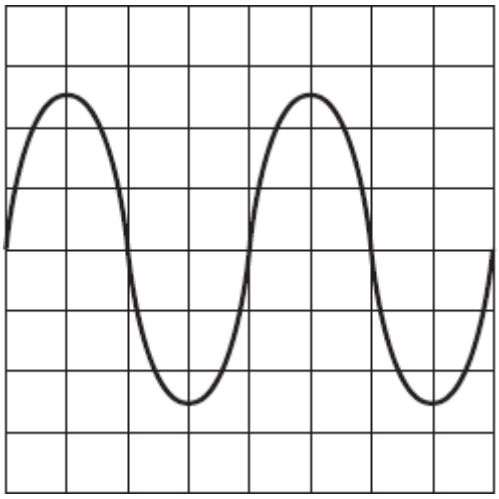
(1)
(Total 7 marks)

Q6. An oscilloscope is connected to an alternating current (a.c.) supply.
The diagram shows the trace produced on the oscilloscope screen.



Each horizontal division on the oscilloscope screen represents 0.002 s.

(a) Calculate the frequency of the alternating current supply.

Show clearly how you work out your answer and give the unit.

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.....

Frequency = ...

(3)

(b) What is the frequency of the a.c. mains electricity supply in the UK?

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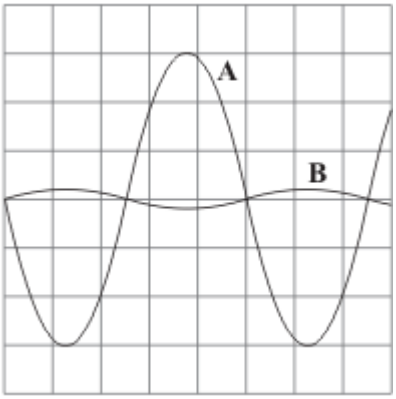
(1)
(Total 4 marks)

Q7. The diagram shows two oscilloscope traces, **A** and **B**.



Trace **A** shows how the potential difference between the live and neutral terminals of an electricity supply changes with time.

(a) Describe how the potential of the live terminal varies with respect to the neutral terminal of the electricity supply.

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(2)

(b) What does trace **B** show?

.....

.....

(1)

(c) Each horizontal division on the oscilloscope represents 0.005 s.

(i) What is the period of this electricity supply?

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Period = ... seconds

(1)

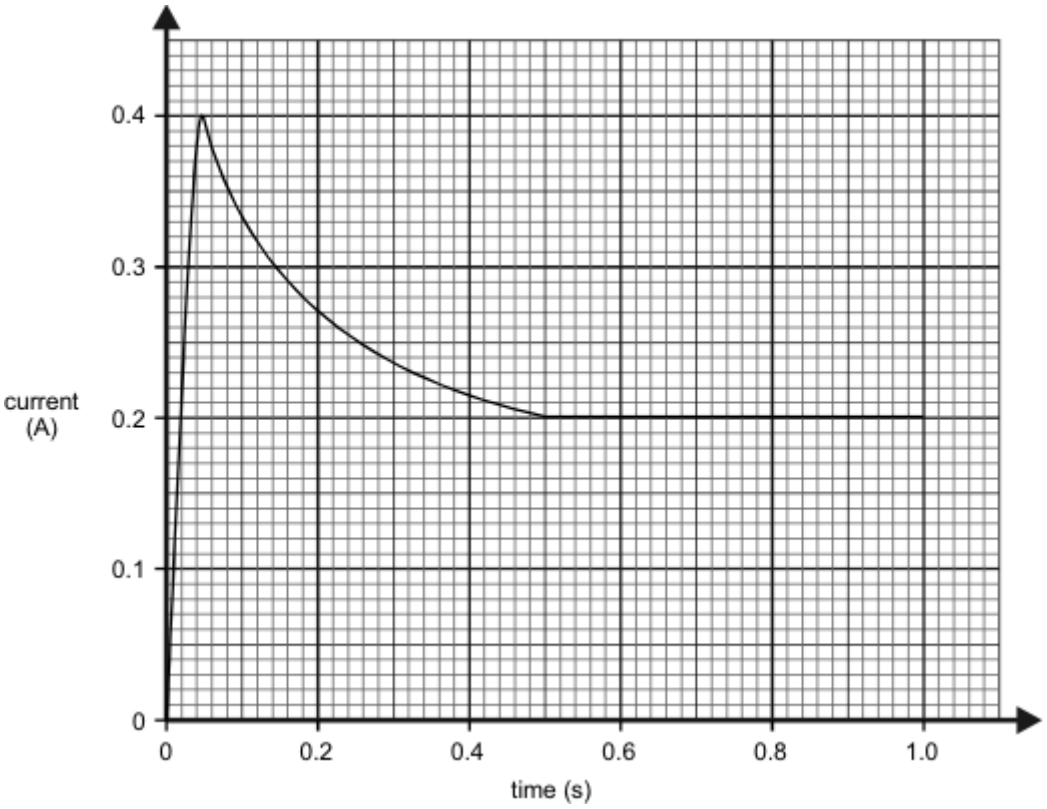
(ii) Calculate the frequency of the supply.

.....

Frequency = ... hertz

(1)
(Total 5 marks)

Q8. When a mains lamp is switched on it takes 0.5 seconds for the filament to reach its normal operating temperature. The way in which the current changes during the first second after switching on is shown in the sketch graph below. Mains voltage is 240 V.



(a) Calculate the resistance of the filament whilst the lamp is drawing the **maximum** current.

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(3)

(b) Describe how the resistance of the lamp changes after the current has reached its maximum value.

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(2)

(c) Calculate the **maximum** power taken by the lamp.

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(2)

(d) Calculate the power of the lamp in normal use.

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(2)

(e) Calculate the energy used by the lamp in six hours of normal use.

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(3)

(Total 12 marks)